International Journal of Research In Vocational Studies (IJRVOCAS)
Vol. 4 No. 4 (2024): IJRVOCAS –Special Issues – INCOSTIG – pp. 01~06
Print ISSN 2777-0168| Online ISSN 2777-0141| DOI prefix: 10.53893
https://journal.gpp.or.id/index.php/ijrvocas/index

Implementation of Environmental Parameter Control System in Green House to Increase Vegetable Production

Afritha Amelia[1,*], Bakti Viyata Sundawa[1], Roslina[1] & Rahimah Abdul Rahman[2]

[1]Department of Electrical Engineering, Politeknik Negeri Medan, Sumatera Utara, Indonesia
[2]Department of Electrical Engineering, Politeknik Tuanku Sultanah Bahiyah, Kulim Kedah, Malaysia

Email address:
afrithaamelia@polmed.ac.id

To cite this article:

Amelia, A., Sundawa, B. V., Roslina, & Rahman, R. A. (2025). Implementation of Environmental Parameter Control System in Green House to Increase Vegetable Production. *International Journal of Research in Vocational Studies (IJRVOCAS)*, 4(4), 01–06. https://doi.org/10.53893/ijrvocas.v4i4.308

Received: 10 20, 2024; **Accepted**: 11 25, 2024; **Published**: 01 31, 2025

Abstract: The use of green houses in plant cultivation is one way to approach optimal conditions for plant growth. Green houses are generally useful for protecting plants from extreme air temperatures. This requires further study of the smart features that will be built to support the concept of greenhouse agriculture. The development of automation technology is expected to help the monitoring system of parameters that affect the production of vegetable crops such as air temperature, and air humidity. These parameters will be monitored remotely using the Internet of Things (IoT) method. Based on the measurement results from the location at POLMED campus. For Medan Selayang the maximum temperature is 26.4^{o}C and humidity is 68.8%. For the location in Medan Johor the maximum temperature is 25.4^{o}C and humidity is 68.1%. For Medan Baru location, the maximum temperature is 25.1^{o}C and humidity is 68.3%. For Medan Helvetia location, the maximum temperature was 24.7^{o}C and humidity was 69%. Based on the test results, the temperature and humidity parameters can be monitored remotely by 106.4 km via the internet.

Keywords: Green House, Smart System, Production of Vegetables, Internet of Things (IoT)

1. Introduction

The use of Green House in plant cultivation is one way to approach optimal conditions for plant growth [1][2]. Green House was first developed and commonly used in subtropical climates aimed at protecting plants from extreme air temperatures such as too hot or too cold [3][4].

Green House is defined as a building for plant cultivation, which has a translucent roof and wall structure [5][6]. The light is needed by plants [7]. Plants are also protected from unfavorable environmental conditions, namely air temperatures that are too low, rainfall that is too high, and winds that are too strong [8].

Environmental parameters in the Green House that affect the growth of vegetable plants, namely sunlight, air temperature, air humidity, and carbon dioxide concentration [9][10]. Green House technology is a modification of the environment to suit or approach optimal conditions for plant growth [11].

The working concept of the Green House is sunlight, which is an integral part of the Green House, radiates its light into the Green House building. The heat is difficult to get out again. This heat is what can warm the soil and for plant photosynthesis. The Green House is impermeable or the outside conditions do not really affect the inside. The Green House will be easier to control and monitor.

For this reason, further studies are needed on the Smart System that will be built to support the Green House concept. By the development of automation technology at this time, it is expected to help the monitoring system of environmental parameters that affect the growth of vegetable plants, namely sunlight, air temperature, air humidity, and carbon dioxide concentration [12]. This Smart System will be monitored remotely using the Internet of Things (IoT) method [13][14][15].

2.Method

2.1. Research Stages

This research is explained through a fishbone diagram as in Figure 1.

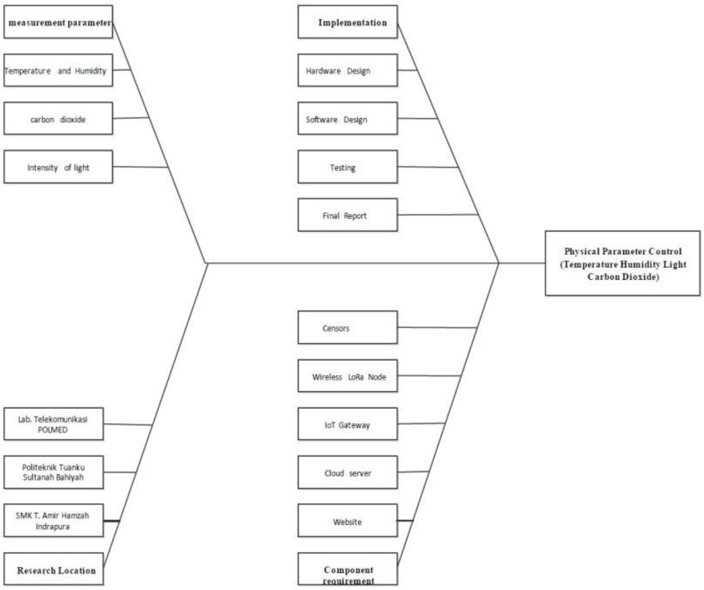


Figure 1. Fishbone diagram of research

The research fishbone diagram above explains Prototype Implementation of Physical Parameter Control System (Temperature and Humidity) in Green House is built with 4 main components, namely: Implementation consists of hardware design, software design, prototype testing and preparation of the final research report. The parameters to be measured are temperature and humidity, Component requirements consist of sensors, Wireless LoRa Node, IoT Gateway, Cloud Server, and website on the user side and The research location was conducted at the Telecommunications Laboratory of Politeknik Negeri Medan (Polmed) and the Green House of SMK T. Amir Hamzah Indrapura.

2.2. Research Model

This research uses an IoT Gateway as an interface device to collect multiple data from various remote areas and send the transparent data to the Cloud Server. The system will be able to monitor several Wireless LoRa Node devices and collect temperature and humidity data by this device.

The following is a schematic drawing of the IoT Gateway network as shown in Figure 2. All measurement data related to environmental parameters will then be sent to the Cloud Server using the GSM network.

Figure 2. IoT Gateway BL-281

2.3. Research Design

The research design is described in the form of a block diagram as in Figure 3. There are 5 main blocks, namely sensors, Wireless LoRa Node, LoRa Network, IoT Gateway, GSM cellular network, Cloud Server, and website applications for users.

2.4. Data Collection and Analysis Technique

This system is for monitoring the environmental conditions in the Green House. The parameters to be measured in this research are CO_2 concentration, air temperature and humidity, and light intensity. All measured data on the Cloud Server. The network used to transmit data from the sensor to the IoT Gateway is the LoRa Network. The transmitting distance that can be traveled is about 2-3 km. The network used for sending data from the IoT Gateway to the Cloud Server is the GSM Cellular Network. This network can reach almost all regions in Indonesia, so that information about the environment can be accessed online and the information can be seen in real-time.

By this monitoring system, we can ensure that the environmental conditions in the Green House are maintained. We can identify if there are abnormalities or extreme conditions. All information obtained will help interested parties to analyze and take the necessary actions.

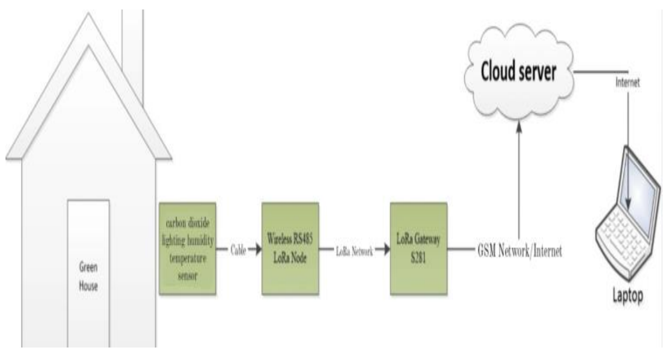
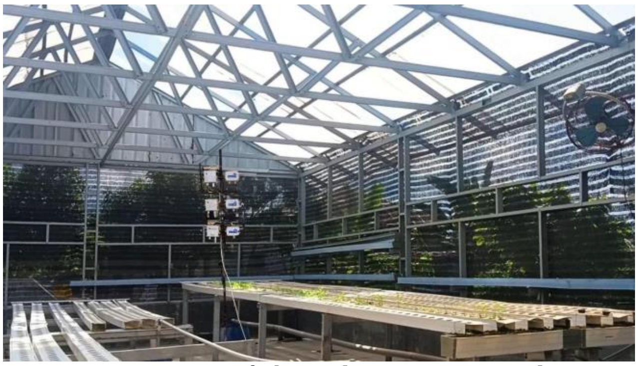


Figure 3. Research block diagram

3. Results and Discussion

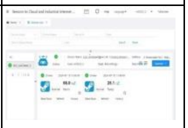
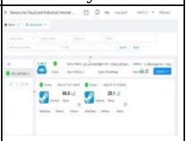
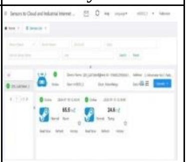
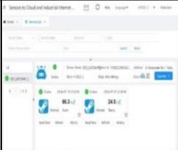
3.1. Research Results

The prototype of the physical parameter control system in the form of temperature and humidity in the greenhouse has been implemented as shown in Figure 4. The location of the control access test was carried out at 5 locations, namely from SMK T Amir Hamzah Indrapura to POLMED campus, to Medan Selayang sub-district, to Medan Johor sub-district, to Medan Baru sub-district and to Medan Helvetia sub-district. For more details can be seen in Table 1. which contains the name of the monitoring location, monitoring distance from the device, and test results in the form of a display from the website.



. Figure 4. Prototype of physical parameter control system (temperature and humidity) installed inside the greenhouse

Table 1. Test results

Number	Name of Location	Monitoring distance to the control system	Test Result
1.	Indra pura to POLMED	 Distance 106.4 km	 Temperature : 25,1 °C Humidity : 68.0%
2.	Indra pura to Medan Selayang Sub district	 Distance 107,1 km	 Temperature : 25,1 °C Humidity : 68.0%
3.	Indra pura to Medan Johor Sub district	 Distance 102,5 km	 Temperature : 24,6 °C Humidity : 65,5 %
4.	Indra pura to Medan Baru Sub district	 Distance 105,6 km	 Temperature : 24,5°C Humidity : 66,3%
5.	Indra pura to Medan Helvetia Sub district	 Distance 119,6 km	 Temperature : 24,7°C Humidity : 69,0%

3.2. Discussion

Based on the measurement results from the location at POLMED the maximum temperature is 26.4°C and the maximum humidity is 68.8%. For Medan Selayang the maximum temperature is 26.4°C and humidity is 68.8%. For the location in Medan Johor the maximum temperature is 25.4°C and humidity is 68.1%. For Medan Baru location, the maximum temperature is 25.1°C and humidity is 68.3%. For Medan Helvetia location, the maximum temperature was 24.7°C and humidity was 69%.

These data are measured in real-time and the measurement results are compared with the temperature and humidity data display in the room where the greenhouse is located. The indoor temperature and humidity data display can be seen in Figure 1. There is an insignificant difference from the results of remote monitoring of temperature and humidity in the greenhouse. Next, the temperature and humidity measurement results for each location are depicted in the graphs as shown in Figure 6 to Figure 15.

Figure 5. Temperature and humidity display in the greenhouse

Figure 6. Temperature graph during the experiment at POLMED

Figure 7. Humidity graph during the experiment at POLMED

Figure 8. Temperature graph during the experiment in Medan *Selayang*

Figure 9. Humidity graph during the experiment in Medan

Selayang

Figure 10. Temperature graph during the experiment in Medan Johor

Figure 11. Humidity graph during the experiment in Medan Johor

Figure 12. Temperature graph during the experiment in Medan Baru

Figure 13. Humidity graph during the experiment in Medan Baru

Figure 14. Temperature graph during the experiment in Medan Helvetia

Figure 15. Humidity graph during the experiment in Medan Helvetia

4. Conclusion

The process of monitoring temperature and humidity is very important to control the plants in the green house. Based on the test results that the test location has been set at 5 locations that are very far apart between the prototype of the monitoring system to the user, namely from SMK T Amir Hamzah Indrapura to POLMED campus Distance 106.4 km, to Medan Selayang sub-district Distance 107.1 km, to Medan Johor sub-district Distance 102.5 km, to Medan Baru sub-district Distance 105.6 km and to Medan Helvetia sub-district Distance 119.6 km. This can be done because all of these locations have been reached by the GSM network so that the monitoring process can be carried out even though it is hundreds of kilometers away. This technology will make it easier for business owners to increase their vegetable production because the conditions for the growth of these plants have been successfully controlled and monitored even from a very long distance.

Acknowledgements

The authors would like to express their sincerest gratitude to the Director of POLMED and the staff of the Research and Public Services Center (P3M) POLMED for their invaluable assistance and for providing the necessary resources and facilities to prepare this work. The authors would also like to extend their appreciation to the Directorate of Vocational Education, Ministry of Education, Culture, Research, and Technology of the Republic of Indonesia for their financial support of this project through DIPA POLMED 2023 with contract number: B/440/PL5.01.05/2024

References

[1] H. Y. Riskiawan *et al.*, “Artificial Intelligence Enabled Smart Monitoring and Controlling of IoT-Green House,” *Arab. J. Sci. Eng.*, vol. 49, no. 3, 2024, doi: 10.1007/s13369-023-07887-6.

[2] D. Saraswathi, P. Manibharathy, R. Gokulnath, E. Sureshkumar, and K. Karthikeyan, “Automation of Hydroponics Green House Farming using IOT,” in *2018 IEEE International Conference on System, Computation, Automation and Networking, ICSCA 2018*, 2018. doi: 10.1109/ICSCAN.2018.8541251.

[3] P. Fensterseifer, E. Gabriel, R. Tassi, D. G. A. Piccilli, and B. Minetto, “A year-assessment of the suitability of a green façade to improve thermal performance of an affordable housing,” *Ecol. Eng.*, vol. 185, 2022, doi: 10.1016/j.ecoleng.2022.106810.

[4] M. V. Rodríguez, A. S. Cordero, S. G. Melgar, and J. M. Andújar Márquez, “Impact of global warming in subtropical climate buildings: Future trends and mitigation strategies,” *Energies*, vol. 13, no. 23, 2020, doi: 10.3390/en13236188.

[5] I. Jaffal, S. E. Ouldboukhitine, and R. Belarbi, “A comprehensive study of the impact of green roofs on building energy performance,” *Renew. Energy*, vol. 43, 2012, doi: 10.1016/j.renene.2011.12.004.

[6] A. H. Alkali, E. G. Dada, A. M. Kida, and A. A. Ali, “Sunlight and Rainfall Activated Retractable Roof,” *Int. J. Comput. Eng. Appl. 12*, vol. XII, no. Ix, 2018.

[7] D. P. Hutabarat, S. Dewanto, and B. Prasetya, “Controllable LED by Using Smartphone Android for Aquascape Environmental Treatment,” in *IOP Conference Series: Earth and Environmental Science*, 2021. doi: 10.1088/1755-1315/794/1/012133.

[8] O. Nilsson, “Winter dormancy in trees,” *Current Biology*, vol. 32, no. 12. 2022. doi: 10.1016/j.cub.2022.04.011.

[9] A. Nowoświat, J. Ślusarek, R. Zuchowski, and B. Pudełko, “The impact of noise in the environment on the acoustic assessment of green houses,” *Int. J. Acoust. Vib.*, vol. 23, no. 3, 2018, doi: 10.20855/ijav.2018.23.31442.

[10] N. Singh, A. K. Sharma, I. Sarkar, S. Prabhu, and K. Chadaga, “IoT-based greenhouse technologies for enhanced crop production: a comprehensive study of monitoring, control, and communication techniques,” *Syst. Sci. Control Eng.*, vol. 12, no. 1, 2024, doi: 10.1080/21642583.2024.2306825.

[11] V. Mamatha and J. C. Kavitha, “Machine learning based crop growth management in greenhouse

environment using hydroponics farming techniques," *Meas. Sensors*, vol. 25, 2023, doi: 10.1016/j.measen.2023.100665.

[12] S. D. Bhagwat, A. I. Hulloli, S. B. Patil, A. A. Khan, and A. S. Kamble, "Smart Green House using IOT and Cloud Computing," *Int. Res. J. Eng. Technol.*, vol. 5, no. 3, 2018.

[13] J. S. Raj and V. A. J, "AUTOMATION USING IOT IN GREENHOUSE ENVIRONMENT," *J. Inf. Technol. Digit. World*, vol. 01, no. 01, 2019, doi: 10.36548/jitdw.2019.1.005.

[14] C. Reddy, "AUTOMATION OF GREENHOUSE USING IOT," *INTERANTIONAL J. Sci. Res. Eng. Manag.*, vol. 06, no. 05, 2022, doi: 10.55041/ijsrem13820.

[15] A. Imam and D. Gaur, "Smart Greenhouse Monitoring using Internet of Things," *Int. J. Adv. Res. Electron. Commun. Eng.*, vol. 7, no. 5, 2018.